How global warming goes against the grain

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PUBLISHED FEBRUARY 24, 2007

The place where most of the world's people could first begin to feel the consequences of global warming may come as a surprise: in the stomach, via the supper plate.

That's the view of a small but influential group of agricultural experts who are increasingly worried that global warming will trigger food shortages long before it causes better known but more distant threats, such as rising sea levels that flood coastal cities.

The scale of agriculture's vulnerability to global warming was highlighted late last year when the Consultative Group on International Agricultural Research (CGIAR), an umbrella organization representing 15 of the world's top crop research centres, issued an astounding estimate of the impact of climate change on a single crop, wheat, in one of the world's major breadbaskets.

Researchers using computer models to simulate the weather patterns likely to exist around 2050 found that the best wheat-growing land in the wide arc of fertile farmland stretching from Pakistan through Northern India and Nepal to Bangladesh would be decimated. Much of the area would become too hot and dry for the crop, placing the food supply of 200 million people at risk.

"The impacts on agriculture in developing countries, and particularly on countries that depend on rain-fed agriculture, are likely to be devastating," says Dr. Louis Verchot, principal ecologist at the World Agroforestry Centre in Nairobi, Kenya.

Wheat, the source of one-fifth of the world's food, isn't the only crop that could be

In a cruel twist of fate, most of the hunger resulting from global warming is likely to be felt by those who haven't caused the problem: the people in developing countries. At the same time, it may be a boon to agriculture in richer northern countries more responsible for the greenhouse gas emissions driving climate instability.

"With climate change, the agricultural areas in Canada, Russia and Europe will expand, while the areas suited for agriculture in the tropics will decline," Dr. Verchot says. "Basically, the situation is that those who are well off now will be better off in the future, and those who are in problems will have greater problems."

Agriculture is vulnerable to global warming because the world's most widely eaten grains -- corn, wheat, and rice -- are exquisitely sensitive to higher temperatures. In the tropics and subtropics, many crops are already being grown just under the maximum temperatures they can tolerate.

Over the 10,000 years that humans have farmed, temperatures have been remarkably stable, at current levels or slightly cooler, and plants are finely attuned to this climate regimen.

Although it doesn't work exactly the same for each crop, a rough rule of thumb developed by crop scientists is that, for every 1-degree Celsius increase in temperatures above the mid-30s during key stages in the growing season, such as pollination, yields fall about 10 per cent.

In the case of rice, researchers found the plants were most sensitive to higher nighttime temperatures. For crops in general, optimum growing conditions generally range from about 20 to 35 degrees, and then diminish sharply. At 40 degrees -- temperatures that are now starting to occur in many areas -- heat stress causes photosynthesis to shut down. Such high temperatures are starting to become more common, such as during the devastating heat wave in much of Europe in the summer of 2003 that killed tens of thousands.

Average global temperatures will likely rise between 1.1 to 6.4 degrees over the next century, according to the authoritative Intergovernmental Panel on Climate Change, suggesting that, over most of the range of future temperatures, crops will suffer

problematic declines. The panel is also warning that global warming will alter rainfall patterns, causing increasing numbers of droughts and floods.

The threatened wheat-growing area around India is known as the Indo-Gangetic Plain. Summer temperatures already sometimes reach a sizzling 45 degrees there, even though global warming is in its early days.

Agricultural researchers with the CGIAR thought the decline in wheat-growing capacity of the plain, which includes the Punjab, was so worrisome they hurriedly made the finding public, although the full study in which it is described, called "Can Wheat Beat the Heat?" is not going to be released until later this year.

That such a fabled agricultural region -- source of one-sixth of the global wheat crop -- could be severely affected by rising temperatures holds symbolic importance, because the Indo-Gangetic Plain represents one of the world's most significant victories against food shortages.

The area "really is the epicentre of the green revolution in the 1970s, where wheat and rice scientists saw the first big gains that were coming out of modern plant-breeding techniques," says Nathan Russell, a spokesman at the CGIAR, which is based in Washington. The worry is that climate change might "erase all of these gains," he says.

Perhaps the best-known worrier about climate change and its impact on agriculture is Lester Brown, founder of the Earth Policy Institute, a U.S. environmental think tank, and proponent of the view that global warming and agriculture are on a collision course.

"It certainly looms large," Mr. Brown says of the threat posed to farming by a warmer world.

Mr. Brown says the global food larder is already so bare that the impact of global warming could be felt at any time -- even as early as this summer -- if it causes rising temperatures or changing precipitation patterns that lead to a crop failure in any major agricultural region.

The food surpluses of yesteryear have been nibbled down to the point where practically nothing is left in the bin for coping with even one disappointing harvest, he says.

"The unfortunate reality is that the cushion for dealing with climate change now is less than it's been for 34 years, because in six out of the last seven years world grain production has fallen short of consumption."

Furthermore, one of the solutions to global warming -- using crops to produce clean-burning bio-fuels such as ethanol -- would accentuate any harvest shortfalls because so much corn, sugar, and soybeans is now being diverted from the dinner plate to the gas tank.

The Earth Policy Institute tracks the world's stockpile of grain -- the amount available in storage after accounting for annual use and production -- and says it's down to only 57 days of consumption. This is close to the modern nadir, a period in the early 1970s of poor harvests when levels fell so low there was only enough for 56 days. That earlier period of short supply prompted a doubling of world grain prices -- an indication of the possible consequences if global warming takes a bite out of harvests.

Even North America's prime piece of agricultural real estate, the continent's equivalent of the Indo-Gangetic Plain, is in the gunsights of climate change.

The models that simulate the likely effects of climate change show the regions warming the most are at mid to high latitudes, and in mid-continental areas far from the moderating effects of oceans.

"Those conditions sort of describe the U.S. corn belt and the Great Plains, the wheat-growing Great Plains of the U.S. and Canada," Mr. Brown says. "Since we are the world's bread basket, if we start losing wheat production and corn production, it's going to affect the entire world."

The study released by CGIAR did find that rising temperatures would cause a remarkable northward shift of the wheat belt. The crop could theoretically be cultivated in a band across the top of North America -- from Cape Harrison, about

midway up the coast of Labrador, to Ketchikan, on the Alaskan panhandle, in the west.

But agricultural experts say don't bother hoping for northern regions to become replacement granaries for losses in the tropics. Trading the rich soils of the Punjab or the U.S. Midwest for the thin soils of Labrador and the north coast of Lake Superior, in other words, is a bit like a gambler discarding an ace for a two. It's probably an unwise bet.

"The northward movement of a climate zone into an area where crops generally have not been grown does not necessarily mean crops like wheat will do well there," says Dr. Hans Braun, director of the global wheat program at CIMMYT, the Mexico-based crop research institute that conducted the wheat study.

Scientists have made another worrisome discovery, this time about carbon dioxide itself, the main greenhouse gas, which is vital for plant development. It had been assumed in the 1980s, based on greenhouse experiments, that an atmosphere richer in carbon dioxide would stimulate plant growth, raising some crop yields by as much as 30 per cent.

That is part of the reason why, up until now, few people worried much about agriculture and global warming. It was thought that, while climate change might wreak havoc on ice-dependent polar bears and low-lying coastal cities, it held a verdant lining for farmers.

But new research published last year based on experiments in the U.S., Japan, Switzerland and New Zealand found the beneficial effects of carbon dioxide were vastly overrated when crops were grown in the more realistic setting of open farm fields, rather than in greenhouses. Corn yields didn't rise at all, and the rise in wheat and rice yields was less than half previous estimates.

To be sure, not everyone is convinced that crop problems are inevitable.

Donald Coxe, global portfolio strategist for BMO Financial Group, says plant breeders have made remarkable advances in producing crops more tolerant of extreme conditions. "It's quite amazing what they can do," he says.

Mr. Coxe, an investment adviser based in Chicago who follows the commodity markets, where prices would skyrocket if food shortages develop, says last year's corn harvest was a case in point.

Illinois, at the heart of the U.S. corn belt, was sizzled by heat and drought, but many farmers still managed a decent crop thanks to seeds bred to give plants more resistance to drought.

"Illinois was a shocker, frankly, last year, even to ag people. They were amazed," he says.

Researchers affiliated with CGIAR have called for a massive program to develop crops that will be able to cope with global warming, and these developments may well pan out.

But if efforts fail, Mr. Brown, for one, is warning the consequences could be dire, because food supplies are essential for global stability.

Smaller grain harvests will translate into sharply higher food prices. Soaring prices, says Mr. Brown, "could lead to urban food riots in scores of countries around the world, and those food riots could lead to political instability and that political instability could begin to undermine global economic progress."

Warming scenarios

The Stern report, the British government's study on the impact of climate change, says a touch of global warming might help agriculture, but even modest temperature increases could create havoc for farmers.

One-degree rise: There is a modest rise in cereal yields in temperate regions, such as Northern Europe, much of the U.S. and Canada.

Two-degree rise: The world's tropical regions will begin to experience yield declines. These could amount to 5 to 10 per cent in Africa.

Three-degree rise: Agricultural yields in higher-latitude countries, such as Canada, are likely to peak. But 150 million to 550 million more people are at risk of hunger

because of declining crops.

Four-degree rise: Yields plunge by up to 35 per cent in Africa and entire regions, such as parts of Australia, are no longer able to support crops.

Five-degree rise: Fish stocks are likely to become imperilled because of rising acidity levels in the oceans.

More than five degrees: It becomes so hot, wide parts of the world may no longer support agriculture, leading to huge numbers of environmental refugees. The Stern report characterizes this as "catastrophic."

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